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FERMILAB-UPC-163

UPC No. 163



GEOMETRY OF THE SUPERCONDUCTING RING

S. Ohnuma

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With the possible exception of DØ long straight, the geometrical layout of the superconducting ring in the tunnel relative to the ideal main ring position is now fixed. This document is meant to be the final record of the layout and also to serve as a handbook for those who are engaged in various activities in the tunnel. Several reports and memos exist on this subject and a short history is given below, the history covering only the events in which I was a participant.

1. April 1979. Tom Collins specified in TM-874 the basic geometry of the superconducting ring and christened it as "The Great Doubler Shift".

2. May 1979. Report on the Design of the Superconducting Accelerator was issued and this included the geometry of the ring as specified in TM-874. The path length of the s.c. ring was slightly different from the main ring path length.

3. March 1981. The revised geometry was specified in TM-1032 where one can also find the geometry of the ideal main ring. All quadrupoles are moved downward along the beamline by 6.137" and the path length is readjusted to be equal to the main ring circumference.

4. March 1981. Geometry of long straights was fully explained in UPC No. 145. Slot lengths for various quadrupoles and spools are introduced here for the first time, the specifications being given by H. Edwards. The abort long straight at CØ is here still a preliminary version.

5. April 1981. Except for CØ long straight, coordinates of all quadrupoles and dipoles are tabulated and the table was distributed to interested parties. The coordinate system was defined by the main

ring stations but it is different from the DUSA^F site coordinates.* For normal cells and the medium-straight cells, this table is still valid. See Tables I - III of this report.

6. June 1981. The second version of CØ abort geometry was specified in a memo. This version was to replace the one given in UPC No.145.

7. July 1981. Thornton Murphy suggested the use of "the standard straight section Doubler beam" as the reference line for specifying the position of all elements in long straights. Accordingly, this was adopted in the computer program CZEROF and a memo was distributed on July 15 explaining the new coordinate system.

8. November 1981. Mike Harrison reported on the final design of CØ abort in UPC No. 153. Although the design is specified by the CZEROF output attached to the report, the existing drawing of CØ long straight is slightly different from the computed results. The difference is not significant but troublesome when one tries to present a consistent picture.

9. June-July 1982. The program SYNC was run by Dave Johnson for the entire s.c. ring including the CØ abort and the special arrangement at DØ as specified by Mike Harrison. This is the only one available for the TevatronII lattice. Another SYNC output for the TevatronI with the low-beta insertion at BØ may be available from Dave Johnson.

10. August 1982. Thornton Murphy suggested a revised version of UPC No. 145 which is by now obsolete in many respects. The present report is the direct result of his request. The final version of DØ long straight will be reported in the near future as another UPC.

Main Ring Stations

Coordinates of all main ring stations in the DUSA^F system are given in Appendix. The origin of the coordinates is at AØ; the positive Y direction is the Project North and the positive X direction is perpendicular to the Y-axis going east. The straight beamline in the transfer hall is 22.000 mrad away from the Project North, toward east. The line connecting AØ with DØ of course goes through the ring center but

* T. L. Collins, "Stations of the Main Ring", TS-2, May 10, 1968.

this line is not perpendicular to the beamline in the transfer hall. The angle is $(\pi/2) - 2.156$ mrad.

1. Regular stations (all except #11, #12, #17, #48 & #49) are 96" from the end of the upstream dipole slot (which is 251" in the circular arc length) and 71.002" from the beginning of the downstream dipole slot. See page 1 of TM-1032.

2. Medium-straight station #17 is 96" from the end of dipole #16-5 slot, 572.957" from the start of dipole #17-4 slot. See page 2 of TM-1032.

3. Station #11 and #49 are exactly 1,182" from the station Ø.

4. Station #12 is 63.95" from the end of dipole #11-5 slot, 71.002" from the beginning of dipole #12-2 slot. See page 5 of TM-1032.

5. Station #48 is 96" from the end of dipole #47-5 slot, 322.002" from the start of dipole #48-3 slot. See page 4 of TM-1032.

Quadrupoles in the superconducting ring

Type	upstream attachment	nominal effective length	downstream attachment	slot length
TQF(D)	18.137"	66.1"	6.763"	91.000"
H32F				
V32D	18.137"	32.07"	6.763"	56.970"
H25F				
V25D	18.137"	25.5"	6.763"	50.400"
H82F(D)	18.137"	82.72"	8.953"	109.810"
H90F(D)	18.137"	90.19"	6.763"	115.090"
N99F*	7.137"	99.4"	6.763"	113.300"

* This type is always designated as F. However, in the tunnel, it is either horizontally focusing or defocusing depending on its location. "N" stands for "No detector".

Locations in the tunnel:

TQF(D)	all regular stations including #17.
H32F, V32D	stations #48 and #12, normal long straights.
H25F, V25D	stations #48 and #12, high-beta long straights.
H82F(D)	matching outer doublet, normal long straights.
H90F(D)	matching outer doublet, high-beta long straights.
N99F	matching inner doublet, all long straights.

Spools in the superconducting ring

<u>Type</u>	<u>slot length</u>	<u>locations</u>
72S	72.002"	all regular stations and at #12.
43S	43.000"	station #48
50S	49.910"	after 82F(D) and 90F(D).

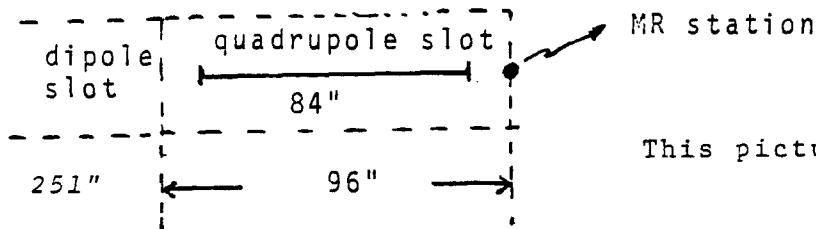
Bypasses

<u>Type</u>	<u>slot length</u>	<u>locations</u>
84B	84.360"	station #49, normal long straights
88B	87.840"	#49, high-beta long straights
125B	125.460"	between N99F and H82D, normal long straights
127B	126.750"	between N99D and H90F, high-beta long straights
261B	261.097"	#48, normal long straights
259B	258.908"	#48, high-beta long straights
387B	387.097"	station B48, upstream of special half-dipole
126B	126.000"	special bypass between C11-2 and C11-3(half-dipole)

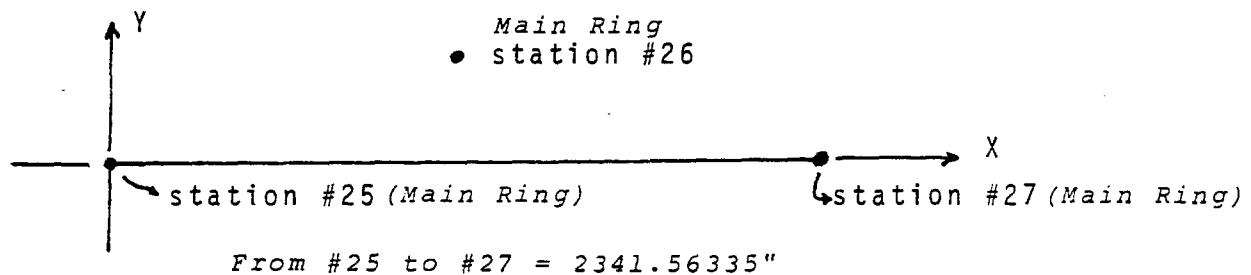
Others

<u>Type</u>	<u>slot length</u>	<u>locations</u>
15STA	15.000"	single turnaround near #49
10STA	10.000"	single turnaround near #11
125 spacer	125.460"	downstream CØ, between N99F & H82D

Table I. Normal Cell (example)



This picture is of the main ring.

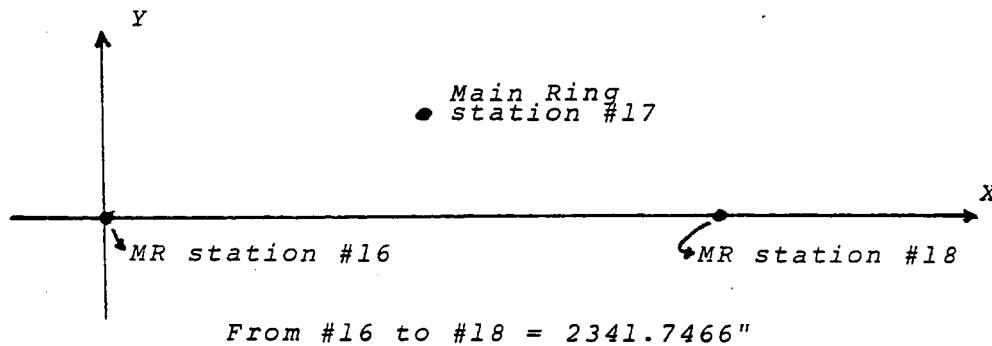


$U = \text{upstream support} = \text{center} - 71'' \text{ (dipole)}$
 $\text{center} - 20.5'' \text{ (quadrupole)}$

$D = \text{downstream support} = \text{center} + 71'' \text{ (dipole)}$
 $\text{center} + 20.5'' \text{ (quadrupole)}$

		X	Y			X	Y		
#25-2	U	108.4432"	3.5909"			#26-2	U	1279.2843	19.0783
	D	250.3826	7.7351			D	1421.2834	18.6122	
#25-3	U	360.3478	10.4991			#26-3	U	1531.2804	17.8047
	D	502.3161	13.4909			D	1673.2710	16.1859	
#25-4	U	612.3002	15.3622			#26-4	U	1783.2578	14.4854
	D	754.2881	17.2015			D	1925.2307	11.7140	
#25-5	U	864.2837	18.1798			#26-5	U	2035.2000	9.1208
	D	1006.2819	18.8664			D	2177.1457	5.1970	
#26-1	U (Q)	1091.9689	18.9816			#27-1	U	2262.7912	2.5303
	D	1132.9689	19.0135			D	2303.7706	1.2311	

Table II. Medium Straight, Upstream



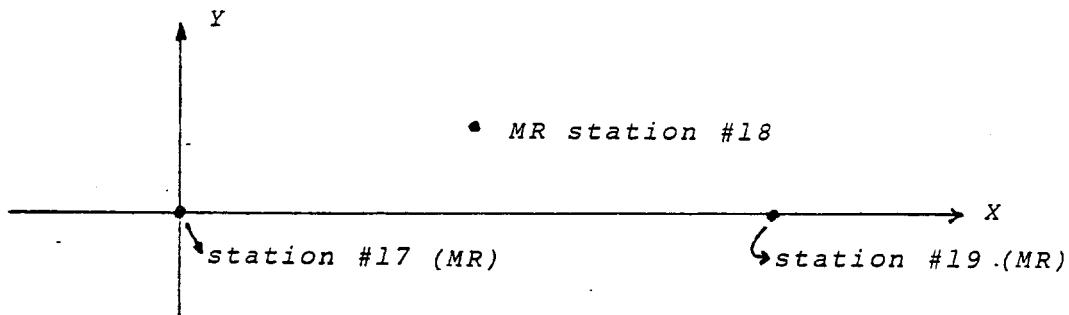
From #16 to #18 = 2341.7466"

U = center - 71" or 20.5"

D = center + 71" or 20.5"

	X	Y		X	Y	
#16-2 U	108.4625"	2.9526"		#17-4 U	1766.8257	9.0584
D	250.4238	6.2614		D	1908.8196	7.7565
#16-3 U	360.4034	8.3781		#17-5 U	2018.8099	6.3016
D	502.3869	10.5344		D	2160.7886	3.8472
#16-4 U	612.3801	11.7583		#18-1 U	2262.9524	1.7149
D	754.3764	12.7619		D	2303.9430	0.8398
#16-5 U	864.3758	13.0928				
D	1006.3756	12.9437				
#17-1 U	1092.0618	12.5546				
D	1133.0613	12.3451				

Table III. Medium Straight, Downstream



From #17 to #19 = 2341.6424"

U = center - 71" or 20.5"

D = center + 71" or 20.5"

	X	Y		X	Y
#17-4 U	595.8501	11.4523	#18-2 U	1279.3235	16.7071
D	737.8336	13.6085	D	1421.3233	16.5579
#17-5 U	847.8268	14.8324	#18-3 U	1531.3218	15.9959
D	989.8231	15.8360	D	1673.3157	14.6941
#18-1 U	1092.0085	16.1922	#18-4 U	1783.3060	13.2392
D	1133.0083	16.3155	D	1925.2847	10.7847
			#18-5 U	2035.2596	8.4370
			D	2177.2136	4.8300
			#19-1 U	2262.8649	2.3545
			D	2303.8471	1.1467

Long Straights, Normal $B\emptyset$, $E\emptyset$, $F\emptyset$
High-beta, $A\emptyset$, ($D\emptyset$) ($D\emptyset$ may change in the near
future.)

The distance Z along the beamline is measured from the main ring station \emptyset (not from the doubler station \emptyset which is nonexistent). This should not be confused with the coordinate X used in Tables IV-VI.

All numbers are in inches. Numbers and elements in parenthesis are for the high-beta long straights $A\emptyset$ and $D\emptyset$. Strictly speaking, Z in $D\emptyset$ is different from Z in $A\emptyset$ by ~ 3 mils but this difference is ignored. Discrepancies of the order of ten to twenty mils are unavoidable and not important as long as they are along the beamline.

Z (inches)

-2,525.101	.....	interface, end of dipole #47-5 slot.
(-2,525.098)		#48-1, H32F=56.970" (H25F=50.400")
-2,468.131	.....
(-2,474.698)		spool 43S=43.000" (43S=43.000")
-2,425.131	.....
(-2,431.698)		bypass 261B=261.097" (259B=258.908")
-2,164.034	.....	interface, beginning of dipole #48-3 slot.
(-2,172.790)		#48-3,4 & 5, 252" each, total 756"
-1,408.034	.....	interface, end of dipole #48-5 slot.
(-1,416.790)		H82F=109.810" (H90D=115.090")
-1,298.224	.....
(-1,301.700)		bypass 84B=84.360" (88B=87.840")
-1,213.864	.....
(-1,213.860)		spool 50S=49.910" (50S=49.910")
-1,163.954	.....
(-1,163.950)		N99D=113.300" (N99F=113.300")
-1,050.654	.....
(-1,050.650)		single turnaround 15STA=15.000" (15STA)
-1,035.654	.....	begin WARM space
(-1,035.650)		WARM SPACE
0.000	.....	Main Ring Station \emptyset

Z (inches)

0.000	.....	Main Ring Station Ø
		WARM SPACE
1,019.664	.....	end warm space
(1,019.660)		10STA=10.000" (10STA)
1,029.664	.....
(1,029.660)		N99F=113.300" (N99D=113.300")
1,142.964	.....
(1,142.960)		bypass 125B=125.460" (127B=126.750")
1,268.424	.....
(1,269.710)		H82D=109.810" (H90F=115.090")
1,378.234	.....
(1,384.800)		spool 50S=49.910" (50S)
1,428.144	.....	interface, beginning of dipole #11-2 slot
(1,434.710)		dipoles #11-2,3,4 & 5, total=1,008.000"
2,436.144	.....	interface, end of #11-5 slot
(2,442.710)		V32D=56.970" (V25D=50.400")
2,493.114	.....
(2,493.110)		spool 72S=72.002" (72S)
2,565.116	.....	interface, beginning of dipole #12-2 slot
(2,565.112)		

around
AØ & DØ

around
BØ,CØ,EØ,FØ

End of #47-5 slot to
end of #48-5 slot

1,108.308"

1,117.067"

End of #48-5 slot to
start of #11-2 slot

A = 2,851.500"
D = 2,851.506"

2,836.178"
2,836.240" for CØ

End of #11-5 slot to
end of #12-5 slot

1,130.402"

1,136.972"

Note: The difference of 6 mils between AØ and DØ
is ignored in the listing above.

Long Straight, CØ Abort

Z (inches)

-2,525.132 interface, end of dipole B47-5
H32F=56.970"

-2,468.162 spool 43S=43.000"

-2,425.162 bypass 387B=387.097"

-2,038.065 interface, beginning of dipole B48-3
special half dipole, slot=126.000"
regular dipoles B48-4 & 5, total=504"

-1,408.065 interface, end of dipole B48-5 slot
H82F=109.810"

-1,298.255 bypass 84B=84.360"

-1,213.895 spool 50S=49.910"

-1,163.985 N99D=113.300"

-1,050.685 single turnaround 15STA=15.000".

-1,035.685 begin WARM space
WARM SPACE (see below)

0.000 CØ (Main Ring Station)
WARM SPACE (see below)

1,019.695 end warm space
single turnaround 10STA=10.000"

1,029.695 N99F=113.300"

1,142.995 125spacer=125.460"

1,268.455

Z (inches)

1,268.455
H82D=109.810"

1,378.265
spool 50S=49.910"

1,428.175 interface, beginning of dipole C11-2 slot
regular dipole, slot=252.000"

1,680.175 bypass 126B=126.000"

1,806.175 interface, beginning of dipole C11-3 slot
special half dipole, slot=126.000"
regular dipoles C11-4 & 5, total=504.000"

2,436.175 interface, end of dipole C11-5 slot
V32D=56.970"

2,493.145
spool 72S=72.002"

2,565.147 interface, beginning of dipole C12-2 slot

WARM SPACE near CØ

For three Lambertsons and two C-magnets, Z can be shifted by
as much as 1/4 inch along the beamline.

Z (inches)

-890.250 to -199.750 Slot for three Lambertson magnets
358.375 to 667.375 Slot for two C-magnets

Lambertson slot: 230.167" each,
C-magnet slot: 154.500" each.

Two coordinate systems are used.

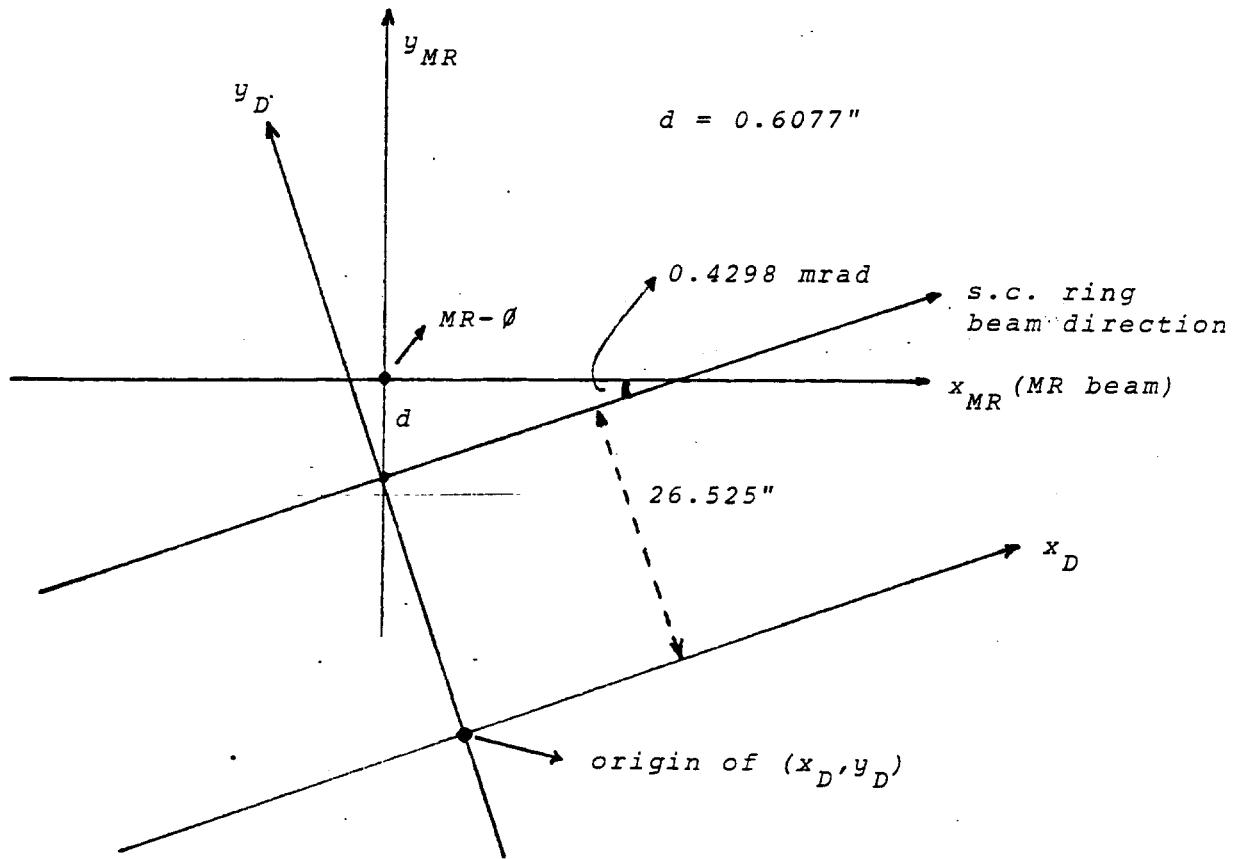
1. Main Ring Station Coordinates. See next page for the definition.
The coordinates are called (x_{MR}, y_{MR}) .
2. Thornton Murphy's Standard Straight Section Doubler Beam.
See below for the definition. Symbols used are (x_D, y_D) .

$$x_D = c \cdot x_{MR} + s \cdot y_{MR} + 0.00026"$$

$$c \equiv \cos(0.4298 \text{ mrad})$$

$$y_D = c \cdot y_{MR} - s \cdot x_{MR} + 27.1327$$

$$s \equiv \sin(0.4298 \text{ mrad})$$



. Definition of (x_{MR}, y_{MR}) coordinates:

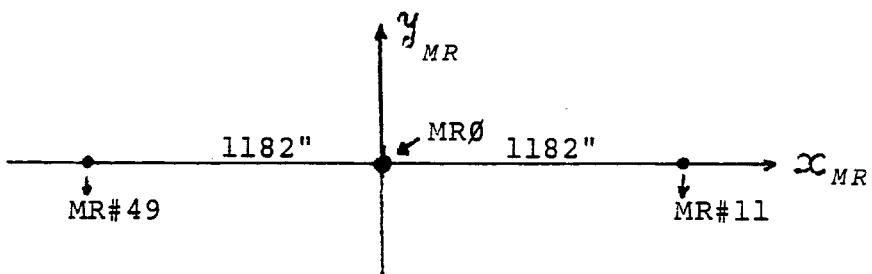


Table IV.

A. normal (BØ, EØ, FØ)

For regular dipoles, U = upstream support (71" from the center) and D = downstream support (71" from the center). "center" = center of iron

	x_{MR}	y_{MR}	x_D	y_D
#48-3 U	-2108.971	- 9.429	-2108.975	18.610
D	-1967.001	- 6.486	-1967.003	21.492
#48-4 U	-1857.017	- 4.653	-1857.019	23.278
D	-1715.028	- 2.863	-1715.029	25.007
#48-5 U	-1605.032	- 1.923	-1605.032	25.900
D	-1463.034	- 1.285	-1463.034	26.477
82F center	-1348.536	- 1.187	-1348.536	26.525
99D center	-1107.116	- 1.083	-1107.116	26.526
99F center	1086.501	- 0.140	1086.501	26.526
82D center	1327.921	- 0.037	1327.921	26.525
#11-2 U	1483.144	- 0.019	1483.144	26.476
D	1625.143	- 0.534	1625.143	25.900
#11-3 U	1735.140	- 1.380	1735.140	25.007
D	1877.130	- 3.048	1877.129	23.278
#11-4 U	1987.116	- 4.787	1987.114	21.492
D	2129.088	- 7.607	2129.085	18.611
#11-5 U	2239.056	-10.239	2239.052	15.931
D	2381.001	-14.212	2380.995	11.897
32D center	2470.128	-17.020	2470.121	9.051

Table V.

B. <u>high-beta</u> (AØ, DØ)		U & D = support points "center" = center of iron		
		x _{MR}	y _{MR}	x _D
#48-3	U	-2117.727	- 9.646	-2117.731
	D	-1975.757	- 6.703	-1975.759
#48-4	U	-1865.773	- 4.870	-1865.775
	D	-1723.784	- 3.080	-1723.785
#48-5	U	-1613.788	- 2.140	-1613.789
	D	-1471.790	- 1.502	-1471.790
90D center		-1353.557	- 1.403	-1353.557
99F center		-1107.112	- 1.296	-1107.112
99D center		1086.497	- 0.354	1086.497
90F center		1332.942	- 0.248	1332.942
#11-2	U	1489.710	- 0.229	1489.710
	D	1631.709	- 0.745	1631.709
#11-3	U	1741.706	- 1.590	1741.705
	D	1883.696	- 3.258	1883.695
#11-4	U	1993.682	- 4.997	1993.680
	D	2135.654	- 7.818	2135.651
#11-5	U	2245.622	-10.449	2245.618
	D	2387.566	-14.422	2387.560
25D center		2473.411	-17.125	2473.404
				8.945

Table VI. CØ Abort Long Straight "center" = center of iron
U & D = support points

	x_{MR}	y_{MR}	x_D	y_D
B48-3 slot, upstream end	-2,037.994	-7.621	-2,037.997	20.388
downstream end	-1,912.026	-4.742	-1,912.028	23.212
B48-4 U	-1,857.038	-3.641	-1,857.039	24.290
D	-1,715.058	-1.249	-1,715.058	26.621
B48-5 U	-1,605.067	0.157	-1,605.067	27.980
D	-1,463.073	1.397	-1,463.072	29.159
82F center	-1,348.577	1.982	-1,348.576	29.694
99D center	-1,107.160	3.109	-1,107.158	30.718
Lambertson L1 slot, upstr. end	-890.264	4.122	-890.262	31.637
Lambertson L2 slot, upstr. end	-660.099	4.987	-660.097	32.403
Lambertson L3 slot, upstr. end	-429.933	5.428	-429.930	32.745
L3 downstr. end	-199.767	5.447	-199.764	32.666
C1 slot, upstr. end	358.359	4.983	358.361	31.962
C2 slot, upstr. end	512.859	4.740	512.861	31.652
C2 slot, downstr. end	667.358	4.265	667.360	31.111
99F center	1,086.512	2.667	1,086.513	29.333
82D center	1,327.930	1.747	1,327.931	28.309
C11-2 U	1,483.151	1.107	1,483.152	27.602
D	1,625.147	-0.010	1,625.147	26.424
C11-3 slot upstream end	1,806.135	-2.121	1,806.134	24.235
C11-3 slot downstream end	1,932.123	-3.868	1,932.121	22.434
C11-4 U	1,987.115	-4.787	1,987.113	21.492
D	2,129.087	-7.607	2,129.084	18.611
C11-5 U	2,239.055	-10.238	2,239.051	15.932
D	2,381.000	-14.211	2,380.994	11.898
32D center	2,470.127	-17.019	2,470.120	9.052

APPENDIX Coordinates of the Main Ring Stations
DUSAf System (see pp.2-3).

Column 1: station

Column 2: angle from the Project North, in radians

Column 3: X in feet

Column 4: Y in feet

Column 5: total number of dipoles to that station

A0	.022000	0.000	0.000	0
A11	.022000	2.167	98.476	0
A12	.054471	6.135	209.199	4
A13	.086942	13.062	306.531	8
A14	.119414	23.146	403.587	12
A15	.151885	36.375	500.264	16
A16	.184356	52.736	596.460	20
A17	.216827	72.212	692.075	24
A18	.233063	93.662	787.266	26
A19	.265534	117.770	881.819	30
A21	.298006	144.934	975.540	34
A22	.330477	175.128	1068.329	38
A23	.362948	208.317	1160.089	42
A24	.395419	244.468	1250.723	46
A25	.427891	283.543	1340.136	50
A26	.460362	325.499	1428.233	54
A27	.492833	370.294	1514.922	58
A28	.525304	417.880	1600.110	62
A29	.557775	468.206	1683.709	66
A32	.590247	521.220	1765.630	70
A33	.622718	576.865	1845.786	74
A34	.655189	635.083	1924.094	78
A35	.687660	695.813	2000.470	82
A36	.720132	758.991	2074.834	86
A37	.752603	824.549	2147.109	90
A38	.785074	892.420	2217.216	94
A39	.817545	962.530	2285.083	98
A42	.850017	1034.808	2350.639	102
A43	.882488	1109.175	2413.813	106
A44	.914959	1185.554	2474.539	110
A45	.947430	1263.864	2532.754	114
A46	.979902	1344.023	2588.396	118
A47	1.012373	1425.946	2641.406	122
A48	1.044844	1509.547	2691.728	126
A49	1.069198	1598.991	2742.394	129
B0	1.069198	1685.357	2789.756	129

B0	1.069198	1685.357	2789.756	129
B11	1.069198	1771.723	2837.117	129
B12	1.101669	1869.596	2889.042	133
B13	1.134140	1957.352	2931.709	137
B14	1.166611	2046.446	2971.504	141
B15	1.199083	2136.786	3008.386	145
B16	1.231554	2228.275	3042.315	149
B17	1.264025	2320.818	3073.256	153
B18	1.280261	2413.981	3102.275	155
B19	1.312732	2507.920	3128.673	159
B21	1.345203	2602.667	3152.008	163
B22	1.377674	2698.121	3172.255	167
B23	1.410146	2794.182	3189.392	171
B24	1.442617	2890.749	3203.402	175
B25	1.475088	2987.720	3214.268	179
B26	1.507559	3084.993	3221.981	183
B27	1.540031	3182.465	3226.532	187
B28	1.572502	3280.033	3227.916	191
B29	1.604973	3377.595	3226.132	195
B32	1.637444	3475.047	3221.181	199
B33	1.669916	3572.287	3213.069	203
B34	1.702387	3669.213	3201.804	207
B35	1.734858	3765.722	3187.399	211
B36	1.767329	3861.712	3169.867	215
B37	1.799800	3957.082	3149.229	219
B38	1.832272	4051.733	3125.505	223
B39	1.864743	4145.563	3098.721	227
B42	1.897214	4238.474	3068.905	231
B43	1.929685	4330.368	3036.088	235
B44	1.962157	4421.148	3000.305	239
B45	1.994628	4510.719	2961.594	243
B46	2.027099	4598.985	2919.995	247
B47	2.059570	4685.855	2875.553	251
B48	2.092042	4771.236	2828.313	255
B49	2.116395	4859.835	2776.186	258
C0	2.116395	4944.035	2725.071	258

C0	2.116395	4944.035	2725.071	258
C11	2.116395	5028.234	2673.957	258
C12	2.148866	5122.139	2615.159	262
C13	2.181338	5202.967	2560.493	266
C14	2.213809	5281.978	2503.233	270
C15	2.246280	5359.088	2443.437	274
C16	2.278751	5434.216	2381.170	278
C17	2.311223	5507.284	2316.496	282
C18	2.327458	5578.996	2250.324	284
C19	2.359929	5648.828	2182.170	288
C21	2.392401	5716.410	2111.784	292
C22	2.424872	5781.671	2039.242	296
C23	2.457343	5844.543	1964.619	300
C24	2.489814	5904.959	1887.994	304
C25	2.522286	5962.855	1809.448	308
C26	2.554757	6018.171	1729.064	312
C27	2.587228	6070.848	1646.926	316
C28	2.619699	6120.831	1563.122	320
C29	2.652171	6168.067	1477.738	324
C32	2.684642	6212.505	1390.867	328
C33	2.717113	6254.100	1302.598	332
C34	2.749584	6292.807	1213.026	336
C35	2.782056	6328.586	1122.244	340
C36	2.814527	6361.399	1030.349	344
C37	2.846998	6391.211	937.436	348
C38	2.879469	6417.991	843.605	352
C39	2.911941	6441.710	748.954	356
C42	2.944412	6462.344	653.582	360
C43	2.976883	6479.871	557.591	364
C44	3.009354	6494.272	461.082	368
C45	3.041825	6505.532	364.156	372
C46	3.074297	6513.640	266.915	376
C47	3.106768	6518.586	169.463	380
C48	3.139239	6520.366	71.901	384
C49	3.163593	6519.522	-30.892	387
DC	3.163593	6517.355	-129.369	387

D0	3.163593	6517.355	-129.369	387
D11	3.163593	6515.189	-227.845	387
D12	3.196064	6511.221	-338.568	391
D13	3.228535	6504.293	-435.900	395
D14	3.261006	6494.210	-532.955	399
D15	3.293478	6480.980	-629.632	403
D16	3.325949	6464.619	-725.829	407
D17	3.358420	6445.144	-821.444	411
D18	3.374656	6423.693	-916.635	413
D19	3.407127	6399.586	-1011.188	417
D21	3.439598	6372.421	-1104.908	421
D22	3.472069	6342.228	-1197.698	425
D23	3.504541	6309.038	-1289.458	429
D24	3.537012	6272.887	-1380.092	433
D25	3.569483	6233.813	-1469.505	437
D26	3.601954	6191.856	-1557.602	441
D27	3.634426	6147.061	-1644.290	445
D28	3.666897	6099.476	-1729.479	449
D29	3.699368	6049.149	-1813.078	453
D32	3.731839	5996.136	-1894.998	457
D33	3.764311	5940.490	-1975.155	461
D34	3.796782	5882.272	-2053.462	465
D35	3.829253	5821.542	-2129.839	469
D36	3.861724	5758.365	-2204.203	473
D37	3.894196	5692.806	-2276.477	477
D38	3.926667	5624.936	-2346.585	481
D39	3.959138	5554.825	-2414.452	485
D42	3.991609	5482.548	-2480.007	489
D43	4.024081	5408.181	-2543.181	493
D44	4.056552	5331.802	-2603.908	497
D45	4.089023	5253.491	-2662.123	501
D46	4.121494	5173.332	-2717.765	505
D47	4.153966	5091.409	-2770.775	509
D48	4.186437	5007.808	-2821.097	513
D49	4.210790	4918.365	-2871.763	516
E0	4.210790	4831.998	-2919.124	516

E0	4.210790	4831.998	-2919.124	516
E11	4.210790	4745.632	-2966.486	516
E12	4.243261	4647.759	-3018.411	520
E13	4.275733	4560.004	-3061.078	524
E14	4.308204	4470.909	-3100.873	528
E15	4.340675	4380.570	-3137.754	532
E16	4.373146	4289.080	-3171.683	536
E17	4.405618	4196.538	-3202.624	540
E18	4.421853	4103.375	-3231.643	542
E19	4.454325	4009.436	-3258.042	546
E21	4.486796	3914.689	-3281.377	550
E22	4.519267	3819.235	-3301.624	554
E23	4.551738	3723.173	-3318.761	558
E24	4.584209	3626.606	-3332.770	562
E25	4.616681	3529.635	-3343.637	566
E26	4.649152	3432.362	-3351.350	570
E27	4.681623	3334.891	-3355.901	574
E28	4.714094	3237.322	-3357.285	578
E29	4.746566	3139.761	-3355.500	582
E32	4.779037	3042.308	-3350.550	586
E33	4.811508	2945.068	-3342.437	590
E34	4.843979	2848.143	-3331.173	594
E35	4.876451	2751.634	-3316.767	598
E36	4.908922	2655.644	-3299.236	602
E37	4.941393	2560.273	-3278.598	606
E38	4.973864	2465.623	-3254.874	610
E39	5.006336	2371.793	-3228.090	614
E42	5.038807	2278.882	-3198.274	618
E43	5.071278	2186.988	-3165.457	622
E44	5.103749	2096.207	-3129.674	626
E45	5.136221	2006.637	-3090.963	630
E46	5.168692	1918.370	-3049.364	634
E47	5.201163	1831.501	-3004.921	638
E48	5.233634	1746.120	-2957.682	642
E49	5.257988	1657.520	-2905.554	645
F0	5.257988	1573.321	-2854.440	645

F0	5.257988	1573.321	-2854.440	645
F11	5.257988	1489.121	-2803.325	645
F12	5.290459	1395.216	-2744.527	649
F13	5.322930	1314.388	-2689.862	653
F14	5.355401	1235.377	-2632.602	657
F15	5.387873	1158.267	-2572.806	661
F16	5.420344	1083.139	-2510.539	665
F17	5.452815	1010.072	-2445.865	669
F18	5.469051	938.359	-2379.693	671
F19	5.501522	868.528	-2311.539	675
F21	5.533993	800.946	-2241.153	679
F22	5.566465	735.684	-2168.610	683
F23	5.598936	672.812	-2093.987	687
F24	5.631407	612.396	-2017.363	691
F25	5.663878	554.500	-1938.817	695
F26	5.696350	499.184	-1858.432	699
F27	5.728821	446.507	-1776.295	703
F28	5.761292	396.524	-1692.490	707
F29	5.793763	349.289	-1607.107	711
F32	5.826234	304.850	-1520.236	715
F33	5.858706	263.255	-1431.967	719
F34	5.891177	224.548	-1342.395	723
F35	5.923648	188.769	-1251.613	727
F36	5.956119	155.957	-1159.717	731
F37	5.988591	126.145	-1066.805	735
F38	6.021062	99.365	-972.974	739
F39	6.053533	75.646	-878.322	743
F42	6.086004	55.012	-782.951	747
F43	6.118476	37.485	-686.960	751
F44	6.150947	23.084	-590.450	755
F45	6.183418	11.823	-493.524	759
F46	6.215889	3.716	-396.284	763
F47	6.248361	-1.231	-298.831	767
F48	6.280832	-3.011	-201.269	771
F49	6.305185	-2.167	-98.476	774
A0	6.305185	.000	.000	774

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UPC No. 163A

September 3, 1982



Fermilab

ADDENDA TO UPC No. 163, "GEOMETRY OF THE SUPERCONDUCTING RING"

A. DØ Long Straight

A possibility exists that we will use special half dipoles at C48-3 and at either D11-3 or D11-4 in the manner of CØ. However, this is still a very preliminary plan and the geometry of DØ is the same as that of AØ as far as the cold area is concerned. Use page 8 and page 9 for Z coordinates, page 14 for (x, y) values. The path length from the end of C48-5 slot to the beginning of D11-2 slot is 2,851.505" which is 5 mils (not 6 mils as reported on p. 9) longer than the corresponding value at AØ. In using pages 8 and 9 and page 14, one is ignoring this difference.

In the warm space around DØ, Mike Harrison is planning to install (in addition to extraction septa) four main ring B2 dipole in order to make a small bypass-like orbit deformation. The exact geometry is dependent on the bend angle of these main ring magnets which will be in series with all other superconducting magnets. Using two reports, TM-814 and UPC #161, I find

$$\begin{aligned} I &= 4.44 \text{kA}, \text{ momentum} = 1 \text{ TeV/c}, \text{ B2 bend angle} = 3.146 \text{ mrad}, \\ &= 3.0 \text{kA}, &= 677 \text{ GeV/c}, &= 3.177 \text{ mrad}. \end{aligned}$$

Tables IA and IB assume the angle to be 3.146 mrad. The position of four B2 dipoles is taken from the existing drawing of DØ area. The position can be off by as much as 1/4" along the beamline. The length of B2 is 239" from endplate to endplate. I am taking the slot length to be 251" (6" each at both ends added) in accordance with the main ring convention.

Table IA. DØ Warm Space

Z = -1,023.902" to -772.902"	MR B2 slot, center at -898.402"
= -362.652" to -111.652"	MR B2 slot, center at -237.152"
= +19.652" to 270.652"	MR B2 slot, center at +145.152"
= 680.902" to 931.902"	MR B2 slot, center at 806.402"

Table IB. DØ Warm Space Elements

This should be used together with Table V on page 14.

	x _{MR}	y _{MR}	x _D	y _D
B2 slot, upstream end	-1,023.899	-1.260	-1,023.899	26.313
B2, center	-898.399	-1.108	-898.399	26.411
B2 slot, downstream end	-772.900	-0.758	-772.900	26.707
B2 slot, upstream end	-362.652	0.709	-362.652	27.998
B2, center	-237.153	1.060	-237.152	28.294
B2 slot, downstream end	-111.653	1.212	-111.652	28.393
B2 slot, upstream end	19.652	1.269	19.653	28.393
B2, center	145.152	1.224	145.153	28.294
B2 slot, downstream end	270.652	0.982	270.653	27.998
B2 slot, upstream end	680.900	-0.133	680.900	26.707
B2, center	806.400	-0.375	806.400	26.411
B2 slot, downstream end	931.900	-0.420	931.900	26.313

B. Path Length of the Superconducting Ring

1. normal half-cell (29 in each sector) = 1,171.002"
2. medium-straight (one in each sector) = 1,170.959"
3. short half-cell near station #12 (one in each sector)
= 1,136.972" for B, C, E, F; 1,130.402" for A & D
4. long straight

1) end of #47-5 slot to the end of #48-5 slot

$$\begin{aligned} &= 1,117.067" \text{ near } B\emptyset, C\emptyset, E\emptyset, F\emptyset \\ &= 1,108.308" \text{ near } A\emptyset \& D\emptyset \end{aligned}$$

2) end of #48-5 slot to the start of #11-2 slot

$$\begin{aligned} &= 2,836.178" \text{ near } B\emptyset, E\emptyset, F\emptyset \\ &= 2,851.500" \text{ near } A\emptyset \\ &= 2,836.240" \text{ near } C\emptyset \\ &= 2,851.505" \text{ near } D\emptyset \end{aligned}$$

3) four dipole slots, #11-2, 3, 4 & 5 = 1,008"

End of F47-5 slot to the end of A47-5 slot = 41,228.227"

End of A(D,E)47-5 slot to the end of B(E,F)47-5 slot = 41,228.234"

End of B47-5 slot to the end of C47-5 slot = 41,228.294"

End of C47-5 slot to the end of D47-5 slot = 41,228.232"

Total: 247,369.455" for the superconducting ring,

(cf. 247,369.465" for the main ring).



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UPC No. 163-R

September 7, 1982

CORRECTIONS TO UPC No. 163 and No. 163A

Thornton Murphy pointed out errors in UPC No. 163 and No. 163A. Errors are in the coordinates (x_D , y_D) of the high-beta long straights AØ and DØ.

On page 12 of UPC No. 163, the picture of the coordinate system shows $d = 0.6077"$ which is true for BØ, CØ, EØ and FØ but should be $d = 0.8209"$ for AØ and DØ. See pages 10 and 11 of TM-1032. As a consequence, all values of y_D should be increased by 0.213" on page 14 of UPC No. 163 and page 2 of UPC No. 163A. I suggest you cut the strips from this note and paste them on appropriate places.

I am grateful to Thornton for pointing out this error and hope that others would be able to find any errors which may still exist.

With apologies,

Sho Ohnuma

y_D

y_D

18.610

26.526

21.492

26.624

23.278

25.007

26.920

25.899

26.476

28.211

26.524

28.507

26.524

28.606

26.524

26.524

28.606

26.476

25.899

28.507

25.007

23.278

28.211

21.492

18.610

26.920

26.624

15.932

11.898

26.526

9.158